



# ADVISORY CIRCULAR

## DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

**SUBJECT:** OPERATIONAL AND AIRWORTHINESS APPROVAL OF AIRBORNE OMEGA RADIO NAVIGATION SYSTEMS AS A MEANS OF UPDATING SELF-CONTAINED NAVIGATION SYSTEMS

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1. PURPOSE. This advisory circular sets forth an acceptable means, but not the only means, of obtaining airworthiness and operational approval of airborne OMEGA navigation systems used in updating self-contained navigation systems such as Doppler Radar and Inertial for operations outside the United States under FAR Part 121.
  2. CANCELLATION. Advisory Circular No. 120-31 dated 12/15/76 is cancelled.
  3. REFERENCES. Federal Aviation Regulations 21.111; 25.1301, 25.1309; 121.103, 121.121, 121.355, 121.389, 121.405, 121.411, 121.413, 121.415, 121.433.
  4. INFORMATION.
    - a. OMEGA is a radio navigation system which uses very low frequency signals from a worldwide network of eight transmitters. A number of signal processing schemes are used by different manufacturers to provide position and other navigation information to the pilot. When OMEGA systems meet the requirements described below, they may be used to update self-contained navigation systems for operations in oceanic areas or in remote land areas.
    - b. This advisory circular is divided into two sections. The first section deals with the airworthiness approval under FAR 25, and the second section deals with operational approval under FAR 121.
    - c. Guidance concerning the use of OMEGA as the sole means of navigation will be issued as additional OMEGA operating experience is gained. In addition, guidance concerning use of OMEGA as a replacement system in cockpit/LORAN-A operations will be issued at the appropriate time.
    - d. Guidance concerning compliance with the International Civil Aviation Organization (ICAO) Minimum Navigation Performance Specifications (MNPS) will be issued in the near future in a separate advisory circular.
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SECTION 1. AIRWORTHINESS APPROVAL

5. GENERAL. Applicants desiring airworthiness approval of airborne OMEGA navigation systems in accordance with this advisory circular should contact the appropriate FAA Regional Engineering and Manufacturing Office or the Engineering and Manufacturing District Office at an early date prior to start of the evaluation flights.
6. MINIMUM FUNCTIONS NECESSARY WHEN USED AS A POSITION FIXING DEVICE. OMEGA navigation systems used as a position fixing device for updating other equipment such as Doppler Radar or Inertial Navigation should meet the performance requirements of either Section One, Section Two, or Section Three of Radio Technical Commission for Aeronautics Document No. DO-164 entitled "Minimum Performance Standards - Airborne OMEGA Receiving Equipment" dated March 19, 1976. The environmental conditions and test procedures contained in Radio Technical Commission for Aeronautics Document No. DO-160 entitled "Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments" dated February 28, 1975, should also be used in demonstrating compliance. When installed in aircraft, the system should satisfy the following conditions:
  - a. System Data Inputs. The system should provide a means of entry for at least the following data inputs:
    - (1) Present position (initialization and reinitialization).
    - (2) Manual deselection of any transmitting station.
    - (3) Time.
    - (4) Date, if used.
  - b. System Displays. The system should provide a means of displaying to the operator the following information:
    - (1) Present position.
    - (2) Time.
    - (3) Date, if used.
    - (4) Synchronization.
    - (5) Station deselection.
    - (6) Time and position recall in event of power failure up to seven minutes.
    - (7) Annunciation of system not operating in primary OMEGA navigation mode.
    - (8) A warning by adequate visual or aural signals of system failure, malfunctions, accuracy degradation alert (ambiguity light), lack of synchronization, and operation without adequate signals.
7. EQUIPMENT INSTALLATION REQUIREMENTS.
  - a. Location of OMEGA Displays and Controls. System controls and data display should be visible to, and conveniently accessible to, each pilot while seated at his duty station.

- b. Failure Protection. Any probable failure of the airborne OMEGA navigation system should not derogate the normal operation of equipment connected to it.
- c. Environmental Conditions. The OMEGA equipment should be capable of performing its intended function over the environmental ranges expected to be encountered in actual operations.
- d. Electromagnetic Interference. The OMEGA navigation system should not be the source of objectionable electromagnetic interference, nor be adversely affected by electromagnetic interference from other equipment in the aircraft.
- e. Antenna Performance. The antenna design and installation should provide adequate immunity from the effects of precipitation static and other noise or disturbances.
- f. Dynamic Responses. The system operation should not be adversely affected by aircraft maneuvering or changes in attitude encountered in normal operations.
- g. System Controls. The system controls should be arranged to provide adequate protection against inadvertent system turnoff.
- h. Preflight Test. A preflight test capability should be provided to inform the flight crew of system status.
- i. Automated Display. An automated display of the aircraft's present position in suitable coordinates should be provided.
- j. Aircraft Electrical Power Source. The OMEGA equipment should be installed so that it receives its electrical power from a bus that provides the maximum reliability for operation of the OMEGA equipment without jeopardizing service to essential or emergency loads. In the case of two or more OMEGA systems, only one system need receive power from a bus that provides the maximum reliability.
- k. Power Interruption.
  - (1) After a power interruption of up to 7 seconds, the OMEGA equipment should automatically resynchronize and resume normal operation within 3 minutes without operator intervention.
  - (2) After a power interruption of greater than 7 seconds and up to 7 minutes, the OMEGA equipment should either resume normal operation (including proper lane resolution) automatically as above or, as a minimum, retain the last "power-on" OMEGA equipment position and time for display on command.

1. Aircraft Flight Manual. The Aircraft Flight Manual should contain the following information on the OMEGA equipment:
  - (1) Normal procedures for operating the equipment;
  - (2) Equipment operating limitations; and
  - (3) Emergency operating procedures (if applicable).
8. SYSTEM ACCURACY. The system should be capable of meeting at least the accuracy requirements stipulated for long-range navigation systems in FAR Part 121, Appendix G.
9. DEMONSTRATION OF COMPLIANCE. An applicant for approval of an OMEGA navigation system installation should show that he has satisfied the requirements of the entire installed OMEGA system by a combination of ground and flight evaluations defined below:
  - a. Ground Evaluation.
    - (1) After installation, an operational/functional check should be performed to demonstrate compatibility between the OMEGA system and aircraft electrical and electronic systems.
    - (2) This test should be conducted with all electrical/electronic equipment operating normally on aircraft power. A ground location may be selected that minimizes the presence of external electromagnetic interference. In addition, it should be demonstrated that the OMEGA equipment will not adversely load other systems to which it may be connected.
    - (3) The OMEGA velocity and heading (or track) information, if presented on the Control/Display Unit or other interfacing instruments, should have reasonable comparison to the primary indications on other flight deck instruments. During these tests the primary velocity and heading (or track) input to the OMEGA system should be slewed through their operating range.
    - (4) The OMEGA system should be capable of displaying present position with no instability or discontinuity when utilizing those stations being displayed by the system as usable and necessary for navigation.
  - b. Flight Evaluation. The OMEGA navigation system should be checked in flight to determine that the design and installation criteria are met.
    - (1) The applicant for airworthiness approval should provide data from sufficient flights to show that the OMEGA navigation system can be used to update the self-contained navigation system to meet the accuracy requirements stipulated for long-range navigation systems in FAR Part 121 under expected operating conditions.

- (2) It should be demonstrated that operation of the system does not impose an unacceptable workload on the flight crew. This aspect should receive careful scrutiny when position and flight progress readouts from the updating system are presented in a form different from those provided by the primary system.

10.-19. RESERVED.

SECTION 2. OPERATIONAL APPROVAL

20. GENERAL.

- a. The basic requirements under FAR Part 121 for en route navigational facilities are contained in 121.103 and 121.121, which require that "nonvisual ground aids" be available along the route for navigating aircraft within the degree of accuracy required. These nonvisual ground aids are considered to include long-range radio navigation systems such as OMEGA. Airborne navigation equipment requirements are contained in FAR 121.355 and 121.389.
  - b. Applicants desiring operational approval for use of OMEGA systems should contact the Air Carrier District Office or International Field Office charged with the administration of their operating certificate 30 days prior to the start of evaluation flights.
21. REQUEST FOR OPERATIONAL APPROVAL. The request should contain the following information:
- a. Evidence of an FAA Airworthiness Approval of the system, including a description of the system installation.
  - b. A summary of any flight experience that will enhance the history of adequate accuracy and service reliability.
  - c. Training program curricula for crewmembers for initial approval under FAR 121.405, and for maintenance personnel.
  - d. A maintenance program for compliance with Subpart L of FAR Part 121, including the stationing of spare parts and test equipment, and updating of maintenance manuals.
  - e. Proposed revisions to the Operations Manual describing all normal and abnormal system operating procedures, blunder protection procedures including cross-checking of data insertion, detailed methods for continuing the navigation function with partial or complete OMEGA system failure, and methods for determining which system is the most accurate in the event of a large divergence between them. For the purpose of this advisory circular, a large divergence is one which exceeds separation criteria requirements.
  - f. Proposed revisions to the Minimum Equipment List (MEL) concerning OMEGA, with appropriate justification.

- g. A list of operations to be conducted using the system, containing an analysis of each with respect to signal reception for ground synchronization and en route operation, track length, signal absorption by the Greenland icecap, procedures for operating in areas of magnetic compass unreliability (if applicable), availability of other en route aids, and adequacy of gateway and terminal radio facilities to support the system. For the purpose of this advisory circular, a gateway is a specific navigation fix where the use of the long-range system commences or terminates.
- h. Availability of adequate NOTAM service for the transmitters needed to support the operation.

## 22. EQUIPMENT AND EQUIPMENT INSTALLATION.

- a. OMEGA navigation systems should be installed in accordance with the airworthiness approved system installation requirements.
- b. If evaluation flights are made in operations on which a long-range navigation system is required, a navigation system already approved under Part 121 will be used as the primary means of navigation. Approval may be obtained for temporary cockpit arrangements involving installation of the candidate system provided sufficient flights with the system installation in its final form are observed.
- c. Aircraft using OMEGA systems which are subject to lane ambiguity should have a means for meeting ATC separation standards during any period of lane uncertainty and for reacquiring the proper lane when normal system operation is resumed. Thus, an adequate means of dead reckoning within the overall navigation system on board the aircraft is required.
- d. If the navigational capability depends upon the magnetic compass, operations in areas of magnetic compass unreliability will require special consideration.

## 23. TRAINING PROGRAMS.

- a. Initial training programs should include the following:
  - (1) Instruction regarding responsibilities of flight crewmembers, dispatchers, and maintenance personnel.
  - (2) For pilots, instruction in the following:
    - (a) A description of the equipment and manner of installation, theory of operation, and system capabilities and limitations.
    - (b) Normal operating procedures including preflight procedures and testing, data insertion and cross-checking, en route

procedures including periodic cross-checking of system position display against aircraft position.

- (c) Updating procedures, if applicable.
  - (d) Operations in areas of magnetic compass unreliability, if applicable.
  - (e) Abnormal and emergency procedures, including airborne resynchronization, if applicable.
- b. Procedures for operating the navigation system should be incorporated into the recurrent training program for flight crewmembers.
  - c. The training and qualification program should include an in-flight qualification check based on the training program or an equivalent check in a simulator or approved training device, certified by a qualified check airman. Accomplishment of such training during evaluation flights is acceptable. Sufficient flightcrews considered fully qualified by the applicant will be observed by the FAA to determine the overall effectiveness of the training and qualification program.

24. ACCURACY AND RELIABILITY. The applicant should show:

- a. That an adequate in-flight service reliability rate, stated in terms of in-flight mean time between failures (MTBF), is in existence, with no significant unresolved problems remaining.
- b. That the OMEGA navigation system will be used to update the self-contained system to meet accuracy requirements stipulated for long-range navigation systems in FAR Part 121. Systems which become exceedingly inaccurate without displaying a warning indication will be included in the accuracy accounting. Systems which display a failure warning and are subsequently shutdown or disregarded will be included in the accounting of failed systems in paragraph 24a.

25. EVALUATION PROGRAM.

- a. When OMEGA navigation systems are to be used to replace another radio navigation system for updating a self-contained system such as Doppler, only those aspects involving the new system and its interface with the primary system need to be evaluated concerning requirements described in Section 2 of this circular; however, overall system accuracy and reliability should be demonstrated.
- b. Approval by evaluation should be requested as part of the application for operational approval of the use of OMEGA to update the self-contained navigation system.
- c. The applicant should provide data from sufficient flights which show that he is able to use OMEGA to update self-contained navigation

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systems in routine operations so that the requirements of FAR Part 121 are met.

- d. The procedures and crew workload aspects of paragraph 9b(2) should be considered.

26. OPERATIONS SPECIFICATIONS.

- a. After the evaluation is completed, FAA approval is indicated by issuance of operations specifications, or amendment thereto, authorizing the use of OMEGA to update the self-contained navigation system. Approval is limited to those operations or areas where compliance with FAR Part 121 requirements was demonstrated.
- b. The operations specifications will contain applicable limitations or special requirements needed for particular routes or areas, and, where necessary, a list of a sufficient number of OMEGA ground transmitters required to be in operation to provide the necessary amount of redundancy.



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